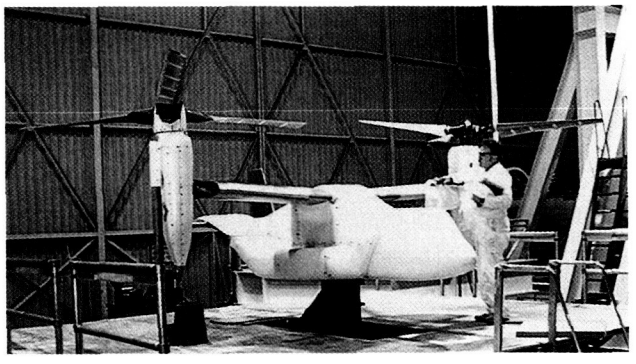

Fig. 1. Full-span TRAM under development at NASA Ames Research Center.

and valuable asset in the development of aeroacoustic analyses for advanced tilt-rotor designs.

In addition to the intensive hardware and instrumentation build-up, significant progress has been made on the FS TRAM, including the complete checkout of two new electromagnetic motors, the left rotor drive system, and the new control system. A 700-channel slip ring was completely wired, and the new rotor hubs were installed. Furthermore, modifications made to the existing microphone traverse system will allow measurements of the acoustic directivity of both rotors. Significant preparations are under way to install a particle image velocimetry system for detailed flow measurements and a laser light sheet system for flow visualization of the rotor wakes.

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Active Control of Tilt-Rotor Aeroacoustics

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Tilt-rotor aircraft have great potential to relieve air traffic congestion by ferrying passengers directly to and from vertiports located near urban areas. Since these aircraft operate like helicopters during landing, the tilt rotors produce highly impulsive noise owing to blade-vortex interactions (BVI). Thus, reducing BVI noise is a key enabling technology that will allow tilt rotors to operate in populated areas. Higher harmonic control (HHC) was shown to be highly effective in reducing BVI noise on tilt rotors. For a three-bladed rotor, an HHC system generates low-amplitude blade-pitch oscillations two, three, and four times per rotor revolution that are superimposed with the primary control input for trim. In addition, practical applications of HHC to tilt rotors require the development of suitable signal processing techniques to identify the radiated BVI noise for feedback control. A method using pressure sensors mounted on the blades for identification and control of BVI noise was demonstrated in an 80- by 120-foot wind tunnel test of a full-scale XV-15 tilt rotor. The controller successfully reduced the BVI noise level by more than 5 decibels, as indicated by the measured noise contours under the rotor shown in the figure on the following page.

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